

# Unheard Voices, Part 2: Women in Astronomy:

A Resource Guide by Andrew Fraknoi (*Foothill College*)

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There is growing documentation of the challenges women have faced and are facing in having an equal role in astronomy. At the same time, women are attaining important positions throughout the astronomical community, including the presidency of the International Astronomical Union and the American Astronomical Society. This means that excellent role models are now available to show girls that they can be an integral part of the human exploration of the universe. Many instructors of astronomy would like to present such role models during their class discussions, but don't have the material to do so at hand or in their textbooks.

Therefore, the Higher Education Working Group within NASA's Science Mission Directorate has sponsored this guide to English-language materials. It is not meant to be a comprehensive introduction to this complex topic, but merely a resource for educators and their students on where to begin looking at the history, the biographical information, and the current issues. Suggestions for additional materials that are both accessible and readable are most welcome.

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*Heidi Hammel*

# 1. The History of Women in Astronomy in General

## A. Books

- Alic, Margaret *Hypatia's Heritage: A History of Women in Science*. 1986, Beacon Press. Chapters on Mary Somerville and Caroline Herschel.
- Armstrong, Mabel *Women Astronomers: Reaching for the Stars*. 2008, Stone Pine Press. Covers the lives and careers of 21 women astronomers, past and present; written for teenagers and up.
- Byers, Nina & Williams, Gary, eds. *Out of the Shadows: Contributions of 20<sup>th</sup> Century Women to Physics*. 2006, Cambridge U. Press. Includes chapters on Payne, Burbidge, and Bell Burnell.
- Ghez, Andrea & Cohen, Judith *You Can Be a Woman Astronomer*. 2006, Cascade Press. A picture book for children from grades 3 - 5.
- Jones, Bessie & Boyd, Lyle *The Harvard College Observatory (1839-1919)*. 1971, Harvard U. Press. Has chapters on the work of a number of key women astronomers.
- Lankford, John "Science and Gender: Women in the American Astronomical Community" in his *American Astronomy*. 1997, U. of Chicago Press. 72-page sociological overview, with statistics.
- Mack, P. "Straying from Their Orbits: Women in Astronomy in America" in G. Kass-Simon & P. Farnes, eds. *Women of Science*. 1990, Indiana U. Press.
- McKenna-Lawlor, Susan *Whatever Shines Should Be Observed*. 2003, Springer. The story of five 19<sup>th</sup> century women who made contributions to astronomy and science; too bad the price from the publisher is inappropriately high for a popular book.

## B. Print Articles

- Dvorak, J. "The Women Who Created Modern Astronomy" in *Sky & Telescope*, Aug. 2013, p. 28. Focuses on the work of Annie Cannon, Antonia Maury, and Wilhelmina Fleming in classifying and understanding stars.
- Greenstein, G. "The Ladies of Observatory Hill" in *American Scholar*, Feb. 1993, p. 437. On pioneering women astronomers at Harvard.
- James, C. "Edward and Mina" in *Astronomy*, July 2002, p. 46. Despite the title, this treats several women who worked at the Harvard Observatory.
- Kidwell, P. "Three Women of American Astronomy" in *American Scientist*, May/June 1990, p. 244. On Cannon, Mitchell, and Payne-Gaposchkin.
- Lankford, J. & Slavings, R. "Gender and Science: Women in American Astronomy 1859-1940" in *Physics Today*, Mar. 1990, vol. 43, p. 58.
- Mack, P. "Strategies and Compromises: Women in Astronomy at Harvard College Observatory" in *Journal for the History of Astronomy*, vol. 21, p. 65 (1990).
- Rizzo, P. "Early Daughters of Urania" in *Sky & Telescope*, Nov. 1954, p. 7.
- Rubin, V. "Women's Work: Women in Modern Astronomy" in *Science* 86, Jul/Aug. 1986, p. 58.
- Spradley, J. "Women and the Stars" in *The Physics Teacher*, Sep. 1990, p. 372.
- Warner, D. "Women Astronomers" in *Natural History*, May 1979, p. 12.



Annie Jump Cannon

### C. Web Resources

Bibliography by Ruth Freitag: <http://www.loc.gov/rr/scitech/womenastro/womenastro-intro.html>

A far more comprehensive and scholarly bibliography, organized by last name, of written articles on women in astronomy. Ruth Freitag's work was the early inspiration for the resource guide you are reading.

4000 Years of Women in Science: <http://www.astr.ua.edu/4000WS/>

Maintained by two women astronomers, this site includes brief information on women from many fields of science, not just astronomy. Their site ends with the start of the 20<sup>th</sup> century, but you can see the much shorter "Contributions of 20<sup>th</sup> Century Women to Physics" at: <http://cwp.library.ucla.edu/>

History of Women in Astronomy: <http://astro.berkeley.edu/~gmarcy/women/history.html>

The text and images from a slide set on women astronomers available from the Astronomical Society of the Pacific. Includes capsule biographies of women from Carolyn Herschel to Sidney Wolff.

She is an Astronomer: <http://www.sheisanastronomer.org/>

This relatively new site, a project of the 2009 International Year of Astronomy, has capsule biographies and useful links to discussions of issues that confront women in astronomy.

The Woman Astronomer: <http://www.womanastronomer.com/>

Debra Davis, a Colorado amateur astronomer, keeps this site and newsletter devoted to both amateurs and professionals.

Gould, Paula "Two Good Women, or Too Good to Be True?" (a 2002 essay from *Science*, considering how Caroline Herschel and Mary Somerville are treated by history, in contrast with men of their time):

<http://www.sciencemag.org/content/296/5574/1805.full>

Women in Astronomy: A Resource Guide by Andrew Fraknoi: <http://www.astrosociety.org/education/astronomy-resource-guides/women-in-astronomy-an-introductory-resource-guide/> (an expanded version of this guide, with many more listings for individual women).

### D. Videos

Jocelyn Bell Burnell (Oxford): "A Celebration of Women in Astronomy" (a talk in 2012 in Edinburgh; we only hear the audio, there is no video, but it is a fascinating public talk with profiles of specific women, including Caroline Herschel and Vera Rubin, and discussions of trends): <http://www.youtube.com/watch?v=50PyimUE5s>

Emily Rice (City University of New York) gives a talk on contributions of women to astronomy (with many historical and contemporary examples and an analysis of modern trends): <http://www.youtube.com/watch?v=5vMR7su4fi8>



Maria Mitchell

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## 2. Materials on a Few Specific Women Astronomers of the Past

### A. Books

Becker, Barbara *Unraveling Starlight: William and Margaret Huggins and the Rise of the New Astronomy*. 2011, Cambridge U. Press. Has much material on Margaret Huggins' role in their partnership and her activities after William's death.

- Belserene, Emelia “Maria Mitchell: 19th Century Astronomer” in *Astronomy Quarterly*, vol. 5, no. 19, p. 133 (1986).
- Berglund, Renee *Maria Mitchell and the Sexing of Science*. 2008, Beacon Press. Story of her life and of the importance of her work and fame for women’s issues.
- Booker, Margaret *Among the Stars: The Life of Maria Mitchell*. 2007, Mill Hill Press. A long biography for adult readers.
- Brock, Claire *The Comet Sweeper: Caroline Herschel’s Astronomical Ambition*. 2008, Totem Books. A popular-level biography.
- Bruck, Mary Agnes *Mary Clerke & the Rise of Astrophysics*. 2002, Cambridge U. Press.
- Burleigh, Robert *Look Up!: Henrietta Leavitt, Pioneering Woman Astronomer*. 2013, Simon & Schuster. A book for children ages 4 – 8.
- Chapman, Allan *Mary Somerville and the World of Science*. 2004, Canopus Books.
- Gingerich, Owen “The Most Brilliant PhD Thesis Ever Written in Astronomy” in Phillip, A. & Koopman, R., eds. *The Starry Universe: The Cecilia Payne-Gaposchkin Centenary*. 2001, L. Davis Press. On the web at: <http://www.harvardsquarelibrary.org/unitarians/payne3.html>
- Gormley, Beatrice *Maria Mitchell: The Soul of an Astronomer*. 1995, Eerdmans Publishing. A book for youngsters.
- Goss, Miller *Making Waves: The Story of Ruby Payne-Scott: Australian Pioneer Radio Astronomer*. 2013, Springer.
- Haramundanis, Katherine, ed. *Cecilia Gaposchkin: An Autobiography and Notes*, 2<sup>nd</sup> ed. 1996, Cambridge U. Press.
- Higgins, F. *Sweeper of the Skies: Caroline Herschel*. 1967, Follett. For young people.
- Hill, Edward *My Daughter Beatrice*. 1986, American Physical Society. About Beatrice Tinsley.
- Johnson, George *Miss Leavitt’s Stars: The Untold Story of the Woman Who Discovered How to Measure the Universe*. 2005, Atlas/Norton. Biography by a science journalist.
- Lemonick, Michael *The Georgian Star: How William and Caroline Herschel Revolutionized Our Understanding of the Cosmos*. 2008, W. W. Norton. A popular-level history of their partnership by a science reporter.
- Lightman, B. “Constructing Victorian Heavens: Agnes Clerke and the ‘New Astronomy’ ” in Gates, Barbara & Shteir, Ann, eds. *Natural Eloquence: Women Reinscribe Science*. 1997, U. of Wisconsin Press.
- McPherson, Stephanie *Rooftop Astronomer: A Story about Maria Mitchell*. 1990, CarolRhoda Books. For younger children.
- Neeley, Kathryn *Mary Somerville: Science, Illumination, and the Female Mind*. 2001, Cambridge University Press.
- Philip, A.G. D., et al, eds. *Anni Mirabiles: A Symposium Celebrating the 90th Birthday of Dorrit Hoffleit*. 1999, L. Davis Press.
- Richardson, Robert “Henrietta Leavitt” and “Lady Huggins” in *The Star Lovers*. 1967, Macmillan.
- Wright, Helen *Sweeper in the Sky: The Life of Maria Mitchell*. 1950, Macmillan. (Recently updated and reprinted by College Avenue Press.)



Caroline Herschel

## **B. Print Articles**

- Bruck, Mary “Agnes Mary Clerke: Chronicler of Astronomy” in *Quarterly Journal of the Royal Astronomical Society*, Mar. 1994, p. 59. Lengthy profile.
- Eisberg, Joann “Making a Science of Observational Cosmology: The Cautious Optimism of Beatrice Tinsley” in *Journal for the History of Astronomy*, vol. 32, p. 264 (2001).
- Faber, Sandra “Beatrice Tinsley” in *Physics Today*, vol. 34, p. 110 (Sept. 1981).
- Hoffleit, Dorrit “Antonia Maury” in *Sky & Telescope*, Mar. 1952, p. 106.
- Hoskin, Michael “Astronomy’s Matriarch” in *Sky & Telescope*, May 2005, p. 42-46. On Caroline Herschel.
- Hughes, D. “Caroline Herschel: Comet Huntress” in *Journal of the British Astronomical Association*, Apr. 1999, vol. 109, p. 78.
- Larson, R. & Stryker, L. “Beatrice Hill Tinsley” in *Quarterly Journal of the Royal Astronomical Society*, vol. 23, p. 162 (1982).
- Levy, D. “Astronomy’s First Lady” in *Sky & Telescope*, Feb. 1999, p. 89. On Dorrit Hoffleit.
- Matyas, C. “Maria Mitchell: First Woman Astronomer in America” in *Science Digest*, Aug. 1961, vol. 50, no. 8, p. 51.
- Mitchell, H. “Henrietta Leavitt and the Cepheid Variables” in *The Physics Teacher*, Mar. 1976, vol. 14, p. 162.
- Opalko, J. “Maria Mitchells’ Haunting Legacy” in *Sky & Telescope*, May 1992, p. 505.
- Patterson, E. “Mary Somerville” in *British Journal for the History of Science*, vol. 4, p. 311 (1969). Long profile.
- Payne-Gaposchkin, Cecilia, two excellent articles about her work and life:  
<http://www.harvardsquarelibrary.org/unitarians/payne2.html>
- Smith, E. “Cecilia Payne-Gaposchkin” in *Physics Today*, June 1980, p. 64.
- Spradley, J. “The Industrious Mrs. Fleming” in *Astronomy*, July 1990, p. 48.
- Weitzenhoffer, K. “The Prolific Pen of Agnes Clerke” in *Sky & Telescope*, Sep. 1985, p. 211.
- Weitzenhoffer, K. “The Triumph of Dorothea Klumpke” in *Sky & Telescope*, Aug. 1986, p. 109.
- Weitzenhoffer, K. “The Education of Mary Somerville” in *Sky & Telescope*, Feb. 1987, p. 138.
- Whitney, C. “Cecilia Payne-Gaposchkin: An Astronomer’s Astronomer” in *Sky & Telescope*, Mar. 1980, p. 212.



Cecilia Payne

## **C. Web Resources**

- Annie Cannon pages at Wellesley College: <http://www.wellesley.edu/Astronomy/Annie/>  
Part of a student project, but with good local historical information.
- Armstrong, Mabel “Nancy Grace Roman: Mother of the Hubble Space Telescope”:  
<http://www.womenastronomers.com/roman.htm>
- Becker, B. “Dispelling the Myth of the Able Assistant: Margaret and William Huggins at Work in the Tulse Hill Observatory” (1992): <https://eee.uci.edu/clients/bjbecker/ExploringtheCosmos/week7b.html>
- Bruck, M. “Mary Somerville: Mathematician and Astronomer of Underused Talent”:  
[http://adsbit.harvard.edu/cgi-bin/nph-iarticle\\_query?bibcode=1996JBAA..106..201B](http://adsbit.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1996JBAA..106..201B)
- DeVorkin, David: Transcript of a 1980 Interview with Nancy Roman for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4846.html>

DeVorkin, David: Transcript of a 1979 Interview with Helen Sawyer Hogg for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4679.html>

Fleming, Wilhelmina: Obituary (1911) by Annie Cannon from the *Astrophysical Journal*: <http://adsabs.harvard.edu/abs/1911ApJ...34..314C> (click on the PDF box at the end to see the article itself)

Gingerich, Owen: Transcript of a 1986 Interview with Margaret Mayall for the Center for the History of Physics: [http://www.aip.org/history/ohilist/28323\\_1.html](http://www.aip.org/history/ohilist/28323_1.html)

Helin, Eleanor (brief interview with): <http://library.thinkquest.org/3806/helininterview.htm>

March 2007 BBC radio program about Caroline Herschel: [http://www.bbc.co.uk/radio4/womanshour/03/2007\\_11\\_thu.shtml](http://www.bbc.co.uk/radio4/womanshour/03/2007_11_thu.shtml)

Mitchell, Maria: Memories of: Harriet Townsend in 1916: [http://womenshistory.about.com/library/etext/bl\\_townsend\\_mitchell.htm](http://womenshistory.about.com/library/etext/bl_townsend_mitchell.htm) ; a student, 1889: [http://womenshistory.about.com/library/etext/bl\\_maria\\_mitchell.htm](http://womenshistory.about.com/library/etext/bl_maria_mitchell.htm) ; profile from 1886: <http://www.female-ancestors.com/daughters/mitchell.htm>

Maria Mitchell reminiscences about her meetings with the Herschels (a magazine article from 1889): <http://womenshistory.about.com/od/mariamitchell/a/Reminiscences-Of-The-Herschels.htm>

Stone, Don “Dorothea Klumpke-Roberts: Pioneer Woman Astronomer”: <http://www.aanc-astronomy.org/articles/dorothea.html>

Sweeney, Brian & Owens, Jay “Beatrice Tinsley: Queen of the Cosmos (1999 short biographical article): <http://www.nzedge.com/beatrice-tinsley/>

Taibi, Richard “Rose O’Halloran”: <http://www.uskyhistory.blogspot.com> (scroll down to the July 18, 2012 entry in this blog; O’Halloran was an astronomer and educator in San Francisco in the late 19<sup>th</sup> and early 20<sup>th</sup> century and the first woman board member of the Astronomical Society of the Pacific).

Trimble, Virginia “Beatrice Tinsley (biography, pdf file): <http://www.ias.ac.in/womeninscience/Tinsley.pdf>

Turner, Margaret “The Life and Work of Beatrice Tinsley”: <http://freepages.misc.rootsweb.ancestry.com/~mturner/women/bmt.htm>

Vassar Encyclopedia Entry on Antonia Maury: <http://vcencyclopedia.vassar.edu/alumni/antonia-maury.html>

Women in Science site (San Diego Supercomputer Center), contains brief biographies of Helen Sawyer Hogg and Annie Cannon: <http://www.sdsc.edu/ScienceWomen/contents.html>

#### **D. Videos**

Video about Annie Cannon’s life and work: <http://cfa-www.harvard.edu/~alexg/ajc.html>

Video of talk by George Johnson on his “Search for Miss Leavitt”:

<http://perimeterinstitute.ca/videos/search-miss-leavitt>

Hypatia and Alexandria (part of a longer film about ancient Alexandria, focusing on the mathematician and astronomer Hypatia):

[http://www.youtube.com/watch?v= MDhDOj0\\_rg](http://www.youtube.com/watch?v= MDhDOj0_rg)

#### **E. Plays**

Gunderson, Lauren: *Silent Sky* (about Henrietta Leavitt): <https://sites.google.com/site/henriettasrhapsody/> and <http://news.discovery.com/space/astronomy/star-fiend-henrietta-leavitt-comes-to-life-on-stage-110415.htm>

For more about the dramatist: <http://laurengunderson.com/>



Henrietta Leavitt



Hoar, Stuart (a New Zealand playwright): *Bright Star* (a play about the work and life of Beatrice Tinsley): [http://www.brightstar-theplay.com/web\\_documents/media\\_release\\_2\\_nov\\_brightstar-theplay\\_nz\\_hobbits.pdf](http://www.brightstar-theplay.com/web_documents/media_release_2_nov_brightstar-theplay_nz_hobbits.pdf) and <http://www.playmarket.org.nz/playwrights/stuart-hoar> and [http://www.remotegoat.co.uk/review\\_view.php?uid=6261](http://www.remotegoat.co.uk/review_view.php?uid=6261)

Nicholas, Siobhán: *Stella* (a play about Caroline Herschel): <http://www.guardian.co.uk/science/blog/2012/may/14/play-astronomer-caroline-herschel> and <http://www.youtube.com/watch?v=nzf1wZNQhY>

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### **3. Issues Facing Women in Astronomy Today**

#### **A. Books and Conference Proceedings**

Kinney, Anne, et al, eds. *Meeting the Challenges of an Increasingly Diverse Workforce: Women in Astronomy and Space Science*. 2009, NASA. The entire book is available free on the web as a PDF file: [http://wia2009.gsfc.nasa.gov/WIA2009\\_proceedings.pdf](http://wia2009.gsfc.nasa.gov/WIA2009_proceedings.pdf)

Urry, C. Megan, et al, eds. *Women in Astronomy: Proceedings of a 1992 Workshop*. 1993, Space Telescope Science Institute.

#### **B. Print Articles**

Bell Burnell, Jocelyn “So Few Pulsars, So Few Females” in *Science*, 23 April 2004, vol. 304. no. 5670, p. 489.

Geller, Margaret “The Black Ribbon” in *Science*, 28 August 1998, vol. 281 no. 5381 p. 1278.

See also the Finkbeiner entry in the next section

#### **C. Web Resources**

American Astronomical Society Committee on the Status of Women: <http://www.aas.org/cswa/>  
A rich site with back issues of the valuable “STATUS” newsletter, a database of living women astronomers, legal resources, conference proceedings, and discussion of issues related to the role of professional women in the astronomy.

Women at NASA: <http://women.nasa.gov/> (Profiles of women who work for the US Space Agency, including a number of astronomers and astrobiologists. The profiles include personal statements that can be quite moving and inspiring.)

Women at Work: A Meeting on the Status of Women in Astronomy: <http://www.stsci.edu/institute/conference/wia/> (Proceedings of a pioneering 1992 meeting with useful local and national perspectives. A second conference was held in 2003: <http://www.aas.org/cswa/WIA2003.html> )

Women in Astronomy and Space Science (A Conference on Diversity Issues Held in 2009). Proceedings can be found at: [http://wia2009.gsfc.nasa.gov/WIA2009\\_proceedings.pdf](http://wia2009.gsfc.nasa.gov/WIA2009_proceedings.pdf)

Women in Planetary Science: <http://womeninplanetaryscience.wordpress.com/profiles/> (Profiles of more than 50 women active in studying the solar system, and a discussion of issues they face)

*She is an Astronomer*: <http://www.sheisanastronomer.org/> (A European site kept by Helen Walker, with profiles of women astronomers outside the U.S., discussions of issues, conference proceedings, varied resources, and more.)

International Astronomical Union Women in Astronomy Working Group (with international statistics and news of world-wide meetings): <http://iauwomeninastronomy.org/>

Women in Astronomy Blog (forthright discussion of issues, opportunities, resources, and networking): <http://womeninastronomy.blogspot.com/>

American Institute of Physics Aug. 2013 Report on Statistics of Women Faculty Members in Physics and Astronomy: <http://www.aip.org/statistics/trends/reports/womenfac-pa-10.pdf>

Finkbeiner, Ann “Good Morning, Gentlemen and Meg: Astronomy, A Woman’s Choice” (an article compiling personal history and suggestions from interviews of 15 noted women astronomers): <http://www.aas.org/cswa/status/2001/JANUARY2001/Finkbeiner.html>

10 Tips for Undergraduate Women Science Students (from Astronomer Sara Seager): <http://www.usnews.com/education/blogs/professors-guide/2010/08/11/10-tips-for-women-students-in-science-fields>

Seager, Sara “So Many Exoplanets, So Few Women Astronomers” (an article in the *Huffington Post* Jan. 2013 about the hardship that constant travel imposes on women scientists with small children): [http://www.huffingtonpost.com/sara-seager/women-in-science\\_b\\_2471980.html](http://www.huffingtonpost.com/sara-seager/women-in-science_b_2471980.html)

*The Baltimore Charter* (spelling out what can be done to help improve the status and working conditions of women in astronomy): <http://www.aas.org/cswa/bc.html>

*The Pasadena Recommendations for Equity* (2003-2005 specific proposals for moving forward toward gender equity): <http://www.aas.org/cswa/pasadenarecs.html>

*Why So Few? Women in Science, Technology, Engineering, and Mathematics* (2010 research report from the Association of University Women discusses key research findings on factors that block women’s participation and progress in science): <http://www.aauw.org/resource/why-so-few-women-in-science-technology-engineering-and-mathematics/>

“Women of Color in Astronomy & Astrophysics” (a 2012 White Paper): <http://sites.nas.edu/wocconference/files/2012/03/6.3.-American-Astronomical-Society.pdf>



Jane Luu

Geller, Margaret “The Black Ribbon” (2004, a poignant essay from *Science* magazine about how discrimination and poverty hold back full participation in science in the U.S.): <http://www.sciencemag.org/content/281/5381/1278.full>

*I Was Wondering* (a web site for children about women in science from the National Academy of Sciences; features a section on Heidi Hammel): [http://www.iwaswondering.org/heidi\\_homepage.html](http://www.iwaswondering.org/heidi_homepage.html)

Encouraging Girls in STEM: A Page of Useful Resources: <http://www.ngcproject.org/engaging-girls-stem> (STEM is science, technology, engineering, and math)

#### **D. Videos**

Women in Astronomy 2009 (a 3-minute video, made in conjunction with the 2009 meeting about women in astronomy. Concise framing of issues through interviews with leaders such as Vera Rubin, Meg Urry, and Dara Norman): <http://www.youtube.com/watch?v=1QyMB0qagZs>

Jocelyn Bell Burnell TED talk on “Reflections on Women in Science: Diversity and Discomfort” (a 15-minute talk with some of her personal history and statistics about women in astronomy): <http://www.youtube.com/watch?v=jp7amRdr30Y>

Meg Urry colloquium on “Women in Science: Why So Few?” (an hour-long illustrated talk on statistics and issues, not specifically about astronomy, but with many eye-opening ideas): <http://vimeo.com/35730552>



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## 4. Materials on a Few Specific Women Astronomers Today

### A. Books

- Bortz, Fred: *Beyond Jupiter: The Story of Planetary Astronomer Heidi Hammel* (2005, Franklin Watts/Scholastic & Joseph Henry Press). A colorful profile of Hammel as a person and scientist, written for teenagers (but enjoyable reading for everyone.)
- Conklin, Nan Dieter *Two Paths to Heaven's Gate*. 2006, NRAO Archives, 520 Edgemont Rd., Charlottesville, VA 22903. A memoir by a pioneering radio astronomer.
- Goldsmith, Donald *The Astronomers*. 1991, St. Martin's Press. The chapter entitled "Mapping the Universe" profiles Margaret Geller's life and work; there is also material on the work of Vera Rubin and Anneila Sargent in the book.
- Hopping, Lorraine *Space Rocks: The Story of Planetary Geologist Adriana Ocampo*. (2006, Joseph Henry Press.) Profile written for teenagers, in the same series as the Bortz book.
- Hu, Esther "Looking Back in Time: Searching for the Most Distant Galaxies" in Stern, S. Alan, ed. *Our Universe: The Thrill of Extragalactic Exploration as Told by Leading Experts*. 2001, Cambridge U. Press; pp. 23-36. Combines a discussion of her work and her development as a scientist. (The same volume also has a similar chapter by Megan Donahue, pp. 107-126.)
- Isbell, Douglas & Strom, Stephen "A Talk with Vera Rubin" in *Observatories of the Southwest*. 2009, U. of Arizona Press.
- Jackson, Ellen *Looking for Life in the Universe: The Search for Extraterrestrial Intelligence*. 2005, Houghton Mifflin. A profile of Jill and her work for young people in grades 4-8.
- Lightman, Alan & Brawer, Roberta "Interview with Sandra Faber" in *Origins*. 1990, Harvard U. Press. (Also has interviews with Margaret Geller and Vera Rubin.)
- Rubin, Vera *Bright Galaxies, Dark Matters*. 1997, American Institute of Physics Press. A collection of her articles, including several personal reminiscences.
- Shoemaker, Carolyn "Ups and Downs in Planetary Astronomy" in *Annual Reviews of Earth and Planetary Science*, vol. 27, p. 1 (1999). Reminiscences about her career.
- Stofan, Ellen "Venus: The Way We Might Have Been" in Stern, S.A., ed. *Our Worlds: The Magnetism and Thrill of Planetary Exploration*. 1999, Cambridge U. Press; pp. 31-45. Combines a discussion of the exploration of Venus with autobiographical information on her development as a scientist.
- Swift, David "Interview with Jill Tarter" in *SETI Pioneers*. 1990, U. of Arizona Press.
- Trimble, Virginia *Visit to a Small Universe*. 1992, American Institute of Physics Press. A collection of her articles, including several that bear on her own life and work.



Jill Tarter

### B. Print Articles

- Bartusiak, M. "The Woman Who Spins the Stars" in *Discover*, Oct. 1990, p. 88. About Vera Rubin and her work.
- Bartusiak, M. "The Remarkable Odyssey of Jane Luu" in *Astronomy*, Feb. 1996, p. 46.

Chaikin, A. "Surveyor of the Universe" in *Air & Space*, Aug./Sept. 1991; vol. 6, p. 84. About the work of Margaret Geller.

Davies, John *Beyond Pluto: Exploring the Outer Limits of the Solar System*. Chapter 4 features Jane Luu's life and work.

Ferron, K. "Brief Interview with Jill Tarter" in *Astronomy*, Dec. 2009, p. 10.

Flamsteed, S. "Star Spots: The Work of Sallie Baliunas" in *Discover*, Dec. 1991, p. 29.

Flanagan, R. "Observer of the Gas Giants" in *Astronomy*, July 1997, p. 50. About Heidi Hammel.

Reed G. "The Discovery of Pulsars: Was Credit Given Where it was Due?" in *Astronomy*, Dec. 1983, p. 24. About Jocelyn Bell Burnell.

Irion, R. "Vera Rubin Profile: The Bright Face Behind the Dark Sides of Galaxies" in *Science*, vol. 295, no. 5557, p. 960 (Feb. 8, 2002).

Levy, D. "Star Trails: Carolyn Shoemaker" in *Sky & Telescope*, June 1991, p. 658.

Lubick, N. "An Ear to the Stars" in *Scientific American*, Nov. 2002, p. 42. A brief profile of Jill Tarter and her SETI work.

Naeye, R. "Unlocking New Worlds" in *Astronomy*, Nov. 2002, p. 48. A profile of Debra Fischer and discussion of her work.

Schomaker, W. "NASA's Visionary" in *Astronomy*, Jan. 2005, p. 48. Interview and profile of Anne Kinney.

Stephens, S. "Hubble Warrior" in *Astronomy*, March 2000, p. 52. Profile of Wendy Freedman's work trying to find the Hubble constant and other cosmological parameters.

Wade, N. "Discovery of Pulsars: A Graduate Student's Story" in *Science*, Aug. 1, 1975, p. 358. Discussed Jocelyn Bell's role in the discovery of pulsars.

Waldrop, M. "New Director Named for Kitt Peak" in *Science*, vol. 224, p. 265 (Apr. 20, 1984). A story about Sidney Wolff.

Wiley, J. "Margaret Geller: Star Mapper" in *Astronomy*, Nov. 2000; vol. 28, p. 104.

### C. Selected Web Resources

Bell Burnell, Jocelyn: Text of a 1977 After-dinner Speech about her Discovery of Pulsars: <http://www.bigear.org/vol1no1/burnell.htm>

Berman, Bob "Debra Elmegreen Challenges Astronomy's Anti-female Legacy" (short profile): <http://physicsandastronomy.vassar.edu/docs/1208-astronomy-magazine-elmegreen.pdf>

Billings, Lee: May 2009 article about Debra Fischer and her work from *Seed Magazine*: [http://seedmagazine.com/content/article/the\\_long\\_shot/](http://seedmagazine.com/content/article/the_long_shot/)

Burbidge, Margaret "Watcher of the Skies" (an autobiographical article from *Annual Reviews* 1994; 37-page PDF): <http://www.annualreviews.org/doi/pdf/10.1146/annurev.aa.32.090194.000245>

Carey, Bjorn "Carolyn Porco: Keeping an Eye on Saturn" (2005 profile and interview): <http://www.space.com/788-carolyn-porco-keeping-eye-saturn.html>

Chapman, Mary: Carolyn Shoemaker Profile (USGS): <http://astrogeology.usgs.gov/people/carolyn-shoemaker>

Davis, Debra "Interview with Debra Fischer" (2008): <http://www.womanastronomer.com/dfischer.htm>

DeVorkin, David "Interview with Margaret Burbidge" 1978, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/25487.html>



Margaret Burbidge

- DeVorkin, David “Interview with Nan Dieter-Conklin” 1977, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4573.html>
- DeVorkin, David “Interview with Dorrit Hoffleit” 1979, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4677.html>
- DeVorkin, David “Interview with Charlotte Moore (Sitterly)” 1978, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4784.html>
- DeVorkin, David “Interview with Nancy Roman” 1980, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/4846.html>
- Eshleman, Adams “Mercedes Richards: Stellar Detective” (Penn State University news story 2009): <http://news.psu.edu/story/141653/2009/08/05/research/stellar-detective-profile-professor-mercedes-richards>
- Sandra Faber 1995 Biographical Sketch: <http://www.physics.ucla.edu/~cwp/articles/faber.htm>
- Freedman, Wendy: Interviews at the National Academy of Sciences in 2004, about her development as a scientist and her work): <http://www.nasonline.org/news-and-multimedia/podcasts/interviews/wendy-l-freedman.html>
- Geller, Margaret “1995 Phi Beta Kappa Speech at Harvard (with some personal reminiscences): <http://gos.sbc.edu/g/geller.html>
- Ghez, Andrea: Interview for PBS NOVA series, first about her work, but then about her development as a scientist): <http://www.pbs.org/wgbh/nova/space/andrea-ghez.html>
- Hammel, Heidi: Answers to Frequently Asked Questions about a Career in Astronomy and more: <http://www.fredbortz.com/HammelBio/AstroFAQ.htm>
- Hersch, Erica “Under the Lens: Astronomer Debra Elmegreen” (a short interview): <http://www.underthemicroscope.com/under-the-lens-astronomer-debra-elmegreen/>
- Kantrowitz, Barbara “Interview with Heidi Hammel” (short, from *Newsweek*, 2007): <http://www.thedailybeast.com/newsweek/2007/11/17/to-shoot-for-the-stars.html>
- Kwok, Roberta “The Stars Her Destination” (a short 2008 profile of Natalie Batalha from the Berkeley Alumni Magazine): <http://alumni.berkeley.edu/news/california-magazine/november-december-2008-stars-berkeley/stars-her-destination>
- Lawler, Andrew “Margaret Geller: Battling Discrimination or Bureaucracy?” in *Science*, 12 November 1999; vol. 286. no. 5443, p. 1277.
- Lightman, Alan “Interview with Sandra Faber” 1988, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/33932.html>
- Lightman, Alan “Interview with Vera Rubin” 1989, for the Center for the History of Physics: <http://www.aip.org/history/ohilist/33963.html>
- Lopes, Rosaly (a brief biography and interview in *Volcano World*): <http://volcanoworld.wordpress.com/2011/12/19/rosaly-lopes/>
- Luu, Jane: Interview from 2003 (with a lot of biographical information): [http://www.imagiverse.org/interviews/janeluu/jane\\_luu\\_21\\_03\\_03.htm](http://www.imagiverse.org/interviews/janeluu/jane_luu_21_03_03.htm)
- McCray, Patrick “Interview with Sidney Wolff” (Wolff was the first woman in history to be the head of a national observatory; Part of the Oral History Interviews at the American Institute of Physics): [http://www.aip.org/history/ohilist/23363\\_1.html](http://www.aip.org/history/ohilist/23363_1.html)



Vera Rubin

McCray, Patrick “Interview with Sandra Faber” for the Center for the History of Physics 2002: <http://www.aip.org/history/ohilist/25489.html>

Mestel, Rosie “Carolyn Shoemaker and Her Comet” (1994 profile from *New Scientist* magazine): [http://www.bibliotecapleyades.net/esp\\_shoemaker\\_a.htm](http://www.bibliotecapleyades.net/esp_shoemaker_a.htm)

My Hero Project: France Cordova (includes biographical information and interview): [http://www.myhero.com/go/hero.asp?hero=dr\\_france\\_cordova](http://www.myhero.com/go/hero.asp?hero=dr_france_cordova)

My Hero Project: Andrea Ghez (includes information about her life and her work, with quotes): [http://www.myhero.com/go/hero.asp?hero=A\\_M\\_Ghez\\_06](http://www.myhero.com/go/hero.asp?hero=A_M_Ghez_06)

My Hero Project: Lucy McFadden (short discussion of her work and how she got into astronomy): [http://www.myhero.com/go/hero.asp?hero=Lucy\\_Mcfadden\\_06](http://www.myhero.com/go/hero.asp?hero=Lucy_Mcfadden_06)

Overbye, Dennis “An Odyssey from the Bronx to Saturn’s Rings” (a 2009 *New York Times* profile of Carolyn Porco): <http://www.nytimes.com/2009/09/22/science/space/22prof.html>

Rubin, Vera “An Interesting Voyage” (an autobiographical article from *Annual Reviews* 2011; 30-page PDF): <http://www.annualreviews.org/doi/pdf/10.1146/annurev-astro-081710-102545>

Rubin, Vera “Margaret Burbidge: AAAS President-Elect” a brief biography from *Science*, vol. 211, p. 915 (Feb. 27, 1981). On the web at: <http://www.physics.ucla.edu/~cwp/articles/burbidge-rubin.html>

Ryan, Alexandra “A Conversation with Laura Danly” (2012, brief article): <http://ww1.calif.aaa.com/westways/2012/05/Pages/conversation-griffith-observatory-danly.aspx?ZIP=92626>

Shoemaker, Carolyn: 1998 Essay from *Science Magazine* on Space Exploration (with thoughts about her own life and work): <http://www.sciencemag.org/cgi/content/full/282/5394/1637>

Snedegar, Jean and Higgins, Suzanne “Kimberly Weaver, Astrophysicist and Inspiring West Virginian”: <http://www.wvpubcast.org/newsarticle.aspx?id=26533>

Sommerville, Iain “From Burtisland to the Outer Limits: The Journey of Anneila Cassells [Sargent]” (mostly about her early life): <http://www.burttisland.net/sargent.htm>

Soter, Stephen & Tyson, Neil: Excerpt from the book *Cosmic Horizons* about Vera Rubin and her work: [http://www.amnh.org/education/resources/rfl/web/essaybooks/cosmic/p\\_rubin.html](http://www.amnh.org/education/resources/rfl/web/essaybooks/cosmic/p_rubin.html)

Wolff, Sidney “Cautions for Astronomy’s Golden Age” (partly autobiographical reflections, 1987): <http://www.the-scientist.com/?articles.view/articleNo/9063/title/Cautions-for-Astronomy-s-Golden-Age/>

#### **D. Selected Videos**

Natalie Batalha: “Finding the Next Earth” (a 2012 talk in the Silicon Valley Astronomy Lecture Series; 1 hr 29 min): [http://www.youtube.com/watch?v=ZbijeR\\_AAo](http://www.youtube.com/watch?v=ZbijeR_AAo)

Jocelyn Bell Burnell: Royal Institution (Public) Discourse in 1997, with nontechnical information about stellar evolution and some reminiscences about her discovery of pulsars (“Tick Tick Tick Pulsating Star”): <http://www.vega.org.uk/video/programme/69>

Laura Danly: “History of Gravity” at the World Science Festival (7 min): [http://worldsciencefestival.com/videos/the\\_history\\_of\\_gravity](http://worldsciencefestival.com/videos/the_history_of_gravity)

Sandra Faber: Interview on the occasion of her winning the 2009 Bower Prize (includes images and reminiscences from many parts of her career; 8 minutes): <http://www.sciencentral.com/video/2009/05/11/sandra-m-faber/> (Another short video about her work can be seen at: <http://news.ucsc.edu/2011/07/faber-emmy.html>)



Sandra Faber

Debra Fischer: 2012 interview on “Yale Live” (22 min): <http://www.youtube.com/watch?v=UahXYEPHoHc>

Margaret Geller: 2013 interview when she won the APS Lillienfeld Prize (6 min): <http://www.youtube.com/watch?v=8c3lM8v68Hw>

Andrea Ghez: 2009 TED talk on the supermassive black hole at the center of the Milky Way (16 min): [http://www.ted.com/talks/andrea\\_ghez\\_the\\_hunt\\_for\\_a\\_supermassive\\_black\\_hole.html](http://www.ted.com/talks/andrea_ghez_the_hunt_for_a_supermassive_black_hole.html)



*Margaret Geller*

Heidi Hammel: 3 minutes on how she got into astronomy, how a mentor helped her, and what she likes to do (great to show young people): <http://www.youtube.com/watch?v=7eSslCoJEjE>

Rosaly Lopes: Discusses her work and work history on “Through the Eyes of Scientists” (3 min, 2011): <http://www.youtube.com/watch?v=ntCPur1SQ4Y>

Carolyn Porco: TED Talk in 2007 on “This is Saturn” (17 min): [http://www.ted.com/talks/carolyn\\_porco\\_flies\\_us\\_to\\_saturn.html](http://www.ted.com/talks/carolyn_porco_flies_us_to_saturn.html)

Sara Seager: Public talk on “Origins and Aliens: The Search for Other Earths” at McMaster University in March 2009 (54 min): <http://www.youtube.com/watch?v=z1-yz0JTmk4>

Ellen Stofan: “Lecture on Exploring Titan by Boat” (2012, at the Denver Museum of Natural History, 1 hr, 18 min): <http://vimeo.com/44046816>

Jill Tarter has given many public talks that are on the web. Here are two shorter ones.

At Zeitgeist 2012: <http://www.youtube.com/watch?v=4EABW8WVTV0>

In 2009, receiving the TED Prize: <http://www.youtube.com/watch?v=EszGlvRdgTE>

Maria Zuber discussing the Grail spacecraft and the MoonKAM educational project at Zeitgeist 2012 (11 min video): <http://www.youtube.com/watch?v=q52AWjZn1Ko>